IN THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE
THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:
Nicolae Miron

Application No. 09/705,447
Filed November 3, 2000

Examiner: Michael A Lyons
Group Art Unit: 2877
Technology Center: 2800

For: BAND PASS INTERFEROMETER WITH TUNING CAPABILITIES

APPELLANT'S BRIEF ON APPEAL

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This is an appeal from a rejection of the Examiner dated December 18, 2003 and a further rejection of the Examiner dated July 19, 2004, rejecting claims 42-133, all of the claims in the case.

PART 1 REAL PARTY IN INTEREST

Optune Technologies, 3549 Ashby Street, St. Laurent, Quebec. Canada H-4R2K3

PART 2 RELATED APPEALS AND INTERFERENCES

None.

PART 3 STATUS OF CLAIMS

This application was originally filed with 41 claims, of which claims 1, 13, 21 and 33 are in independent form. In a first Office action dated September 26, 2002, the Examiner rejected all of the claims 1-41. In Applicant's response dated December 26, 2002, Applicant cancelled claims 1-41 and rewrote them as claims 42-133, of which claims 42, 55, 65, 78, 88, 101, 111 and 124 are in independent form. In a second and final Office action dated March 27, 2003, the Examiner rejected all of the claims 42-133. In Applicant's response dated September 24, 2003, Applicant filed a Request for Continued Examination (RCE) under 37 C.F.R. 1.114, amending the independent claims 42, 55, 65, 78, 88, 101, 111 and 124 to clarify certain limitations and arguing the patentable merits of the claimed invention over the cited art. In a third and non-final Office action dated December 22, 2003, the Examiner rejected all claims 42-133 for obviousness under 35 U.S.C. § 103. In Applicant's response dated June 8, 2004, Applicant, *inter alia,* requested a Personal Interview with the Examiner to discuss the patentability of the claimed invention over the art cited against the claims in the Examiner's prior Office action. By way of facsimile on June 29, 2004 to Applicant's Attorney of Record, Richard I. Samuel, Esq., the Examiner requested that Mr. Samuel provide a detailed agenda as to what Mr. Samuel wished to

discuss during the Personal Interview. In an Office communication dated July 13, 2004, the Examiner indicated that Applicant's response of June 8, 2004 was not fully responsive to the prior Office Action. On August 10, 2004, Applicant filed a Notice of Appeal.

The status of the claims on appeal is as follows: claims rejected: 42-133.

PART 4 STATUS OF AMENDMENTS

Appendix A contains a copy of the pending claims 42-133, as amended and entered.

PART 5 SUMMARY OF THE INVENTION

The Appellant-Applicant's invention is directed to tunable, single- or two-sided interferometers for use as a high resolution wavelength selection units.[1] As shown in FIG. 2A of the drawings, reproduced below, the inventive interferometer operates as a tunable, single-sided interferometer having input and output beams on the same side of the interferometer.

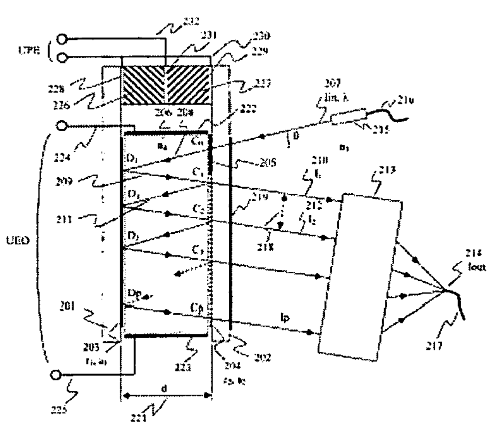

Figure 2a

The single-sided interferometer comprises two transparent optical plates 201 and 202, positioned in parallel relationship so as to present facing sides to each other. Both of the plates

201 and 202 have flat surfaces. The plate 201 has a flat, near total to totally reflective layer, coating or medium 203 with a reflection coefficient r_1 and an absorption coefficient a_1 on the side facing the plate 202. The terms "near total" or "totally reflective" means that very little or no part of a beam's intensity will pass through the reflective layer 203 when said beam is incident on the reflective layer 203. The plate 202 has a flat, partially reflective layer, coating or medium 204 having a reflection coefficient r_2, an absorption coefficient a_2 and a transmission-optimized optical layer/port, coating or medium 205, optimized for maximum transmission of an input beam(s), on the side facing the plate 201. The term "partially reflective" means that a portion of a reflective light beam 208 (i.e., intensity), incident on reflective layer 204 passes through it becoming an output beam 210. The plate 202 also has a transmission-optimized optical layer, coating or medium 219, optimized for maximum transmission of output beam(s), on the side not facing (opposite to) the plate 201, where the output beams are exiting the interferometer. An electro-optical medium 206 is positioned between the flat parallel reflective layers 203 and 204. The electro-optical medium 206 is highly transparent, having an acceptable level of optical non-homogeneities, and an electro-optic refractive index n_2 in the direction of propagating beams. In a preferred embodiment, the electro-optical medium 206 has two electrodes 222 and 223, connected to terminals 224 and 225, respectively. An electro-optical control voltage UEO is applied between the terminals 224 and 225 in order to adjust the refractive index n_2 of electro-optical medium 206 and, by consequence, the elementary optical path difference ("EOPD").

In a preferred embodiment, an adjustable spacer A is located between the optical plates 201 and 202. The selected adjustable spacer medium A adjusts the spacing between optical

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[1] The support for this section is found on pages 16-18 and 28-29 of the application.

plates 201 and 202 while maintaining their parallel relationship with each other. A preferred choice for the adjustable spacer is a conventional high-accuracy piezo-ceramic actuator. As known in the art, the piezo-ceramic actuator typically comprises ceramics 226 and 227, electrodes 228 and 229 connected to a terminal 230, and electrode 231 connected to a terminal 232. A control voltage, such as a piezo-electric control voltage UPE, is applied to and between the terminals 230 and 232, in order to adjust the spacing d between the reflective layers 203 and 204 and by consequence EOPD.

In another embodiment, a controller, such as e.g., a computer, and a displacement sensor, monitors and measures the gap between the reflectors (reflective layers 203 and 204) thereby providing a closed loop system.

As shown below, FIG. 2B of the drawings depicts an alternate embodiment of the present invention, namely, a two-sided interferometer, the only difference being that the two-sided interferometer is adapted to have input and output beams on opposite sides of the interferometer.

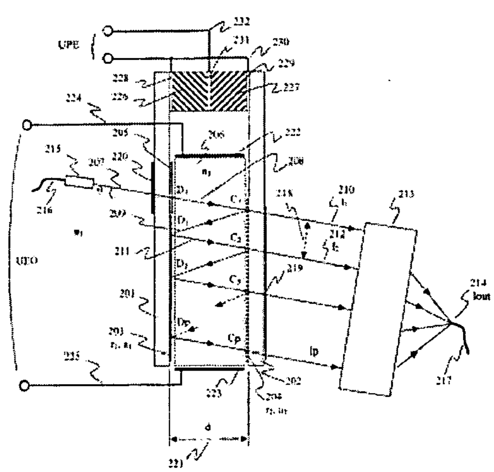


Figure 2b

Everything else being the same, the plate 201 has on the side facing the plate 202, a totally reflective layer, coating or medium 203 with a reflection coefficient $\mathbf{r_1}$ and an absorption coefficient $\mathbf{a_1}$ and an transmission-optimized optical layer or port 205, optimized for maximum transmission of an input beam(s). The plate 201 has another transmission-optimized optical layer or port 220, optimized for maximum transmission of an input beam(s), on the side not facing plate 202.

The present invention provides a number of advantages over the prior art. First, the inventive device has a lower insertion loss than a tunable Fabry-Perot interferometer at the same equivalent finesse, keeping in the same time a constant bandwidth over the tuning range. Second, the inventive device has no eigenmodes and as a result, the device is continuously tunable either by a monotonic function, or by a very large number of non-monotonic steps covering a quasi-continuous wavelength range. Third, the inventive device can work in any wavelength range, by adjusting the gap between the reflectors and eventually by optimizing the reflectors for the working wavelength range of interest. Fourth, the inventive device can work with any polarization of the incident beam, which remains unchanged in the output beam. Fourth, the input optical port and the output optical port can be easily pig-tailed, facilitating the connection of the tunable interferometer with other optical components and assemblies of a fiber-optics system, including cascade connection of several interferometer.

PART 6 ISSUES

The sole issue on appeal arising from the Examiner's rejection is whether claims 42-133 are patentable under 35 U.S.C. § 103 over U.S. Patent No. 3,758,194 to Daval et al in view of U.S. Patent No. 3,551,051 to Salgo in further view of US Patent No. 5,710,655 to Rumbaugh et al.

PART 7 GROUPING OF THE CLAIMS

As to the rejection under 35 U.S.C. § 103, it is Applicant's intention that the rejected claims 42-133 stand or fall together.

PART 8 ARGUMENT - THE PENDING CLAIMS ARE NOT OBVIOUS UNDER 35 U.S.C. § 103

A. Introduction

The Examiner relied on three prior art references, namely US Patent No. 3,758,194 to Daval et al ("Daval"), US Patent No. 3,551,051 to Salgo ("Salgo") and US Patent No. 5,710,655 to Rumbaugh et al ("Rumbaugh"). However, neither of these references, individually or any combination, taught or suggested the Applicant's invention or how its benefits could be obtained to one of ordinary skill in the art at the time of the invention.

B. The Prior Art Relied Upon by the Examiner

(1) U.S. Patent No. 3,758,194 to Daval et al (Daval)

In the Office Action dated December 18, 2003, the Examiner selected Daval as the primary reference under 35 U.S.C. § 103. According to the Examiner:

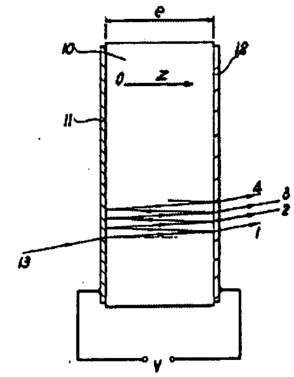
> *With regard to claim 42, Daval discloses (Fig. 1) a first plate 11 and a second plate 12. While the coefficient of reflection of these plates is similar, it is well known to change the coefficient of one substrate so its coefficient is higher than that of the first substrate.*[2]

However, unlike the Applicant's inventive tunable filters, Daval is directed to an interferometric *modulator* which is similar to conventional Fabry-Perot multiple wave devices.[3] With reference

[2] *Examiner's Office Action*, p. 2 (12/18/2003). The Examiner also contends that Daval discloses a refractive index adjuster, "an angled incident light beam entering the etalon," voltage source V, and an electro-optical control voltage device. *Id.* at 3, 5-6.

[3] *Daval*, col. 1, lns. 22-25.

to FIG. 1 of Daval, on the right, the Daval modulator comprises a plate 10 having two parallel faces which is cut at right angles to the optic axis OZ in a uniaxial crystal.[4]



The two faces of the plate are covered by two semi-transparent electrodes 11, 12 each having the same coefficient of reflection of about 0.80.[5] A variable voltage V is applied between the electrodes.[6] Modulating the control voltage is modulated, results in "the modulation of the ordinary index of refraction in the case of a light beam which strikes the modulator in a direction having only a slight deviation from the optic axis OZ and propagates in the crystal in a direction ***parallel*** to the optic axis OZ."[7] The resultant light vibration undergoes successive reflections within the crystal and gives rise to a series of emergent rays.[8]

The Examiner correctly noted that Daval is missing several important limitations of the claims. For example,

> *Daval fails to disclose, however, a beam collimating element and an optical converging element, and the plates are semitransparent electrodes, not substrates as claimed.*[9]
>
> ...
>
> *Daval's device fails to show an adjustable spacer, a displacement transducer, and a controller for monitoring the unable operation of the device.*[10]
>
> ...
>
> *[Daval fails] to disclose a second transmission optimized portion on the outer surface of the first substrate...*[11]

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[4] *Id.* at 53-64.

[5] *Id.*

[6] *Id.*

[7] *Id.* col. 2, lns. 6-15 (emphasis added).

[8] *Id.*

[9] *Examiner's Office Action*, p. 2.

[10] *Id.* at 3.

To overcome Daval's deficiencies, the Examiner attempted to supply the missing limitations by erroneously combining Daval with the teachings of Salgo and Rumbaugh and/or broadly asserting that it would have been obvious to one of ordinary skill in that art at the time the invention was made to include the missing limitation.

(2) U.S. Patent No. 3,551,051 to Salgo ("Salgo")

The Examiner cited Salgo to show the "optical converging element" claim limitation.[12]

> *As for an optical converging element, Salgo shows (Fig. 4) a lens 160 outside the interferometer to collimate the output beams from the interferometer onto a focused point 162.*[13]

Salgo is directed to infra-red detectors. Specifically, Salgo discloses and teaches the use of a point detector utilizing a modified etalon.[14] With reference to FIG. 2 of Salgo, reproduced below, the Salgo etalon comprises a front plate 30 and back plate 31.[15] The front plate 30 is semi-reflecting and a reflecting means at the front surface of the back plate is totally reflecting.[16] A light source 32 is placed to one side of the etalon and its rays are reflected onto the etalon by a semi-transparent mirror 35.[17]

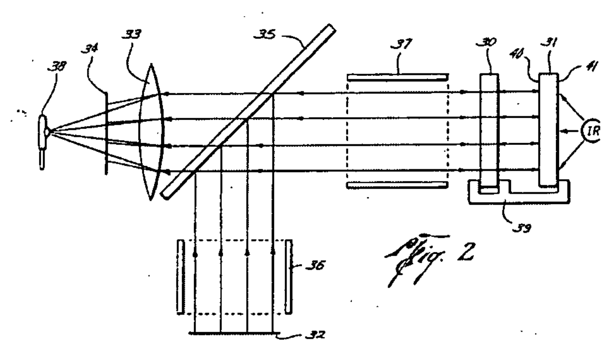

Fig. 2

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[11] *Id.* at 4.

[12] The Examiner also contends that Salgo discloses an adjustable spacer, a light collimator and a voltage source. *See Examiner's Office Action*, at 3, 5-6.

[13] *Id.*

[14] *Salgo,* col. 3, lns. 5-6.

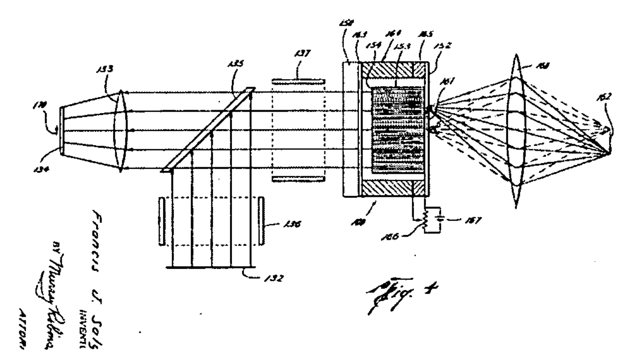
[15] *Id.* at 10-24.

[16] *Id.*

[17] *Id.*

The rays reflected from back plate 31, after one or more transmissions through or reflections from front plate 30, are sent back toward mirror 35 and pass therethrough into lens system 33 which focuses the rays on screen 34.[18] Two collimator devices 36, 37 are provided between the source 32 and the etalon so that "only ***parallel*** rays" fall on and propagate within the etalon.[19] .

With reference to FIG. 4 of Salgo, reproduced below, an infra-red lens means 160 produces an infra-red image 161 on the back of the etalon from the infra-red source 162.[20] It is submitted that Salgo, individually and in combination with Daval fails to render the claimed inventions ***as a whole*** obvious because of fundamental differences between devices.



(3) U.S. Patent No. 5,710,655 to Rumbaugh *et al.* ("Rumbaugh")

Rumbaugh is no more availing to render the present invention obvious. The Examiner cited Rumbaugh as evidence of the first and second "substrate" claim limitations.[21]

> *As for the substrate, Rumbaugh (Fig. la) discloses a cavity thickness compensated etalon filter where the two end plates 10 and 12 are substrates.*[22]

Rumbaugh teaches and discloses an etalon filter which addresses a very narrow problem - the undesirable effects of having non-parallel reflective surfaces within the etalon. It is submitted

[18] *Id.*

[19] *Id.*

[20] *Id.*, col 4, ln. 75-col 5, ln. 2.

[21] The Examiner contends that Rumbaugh also discloses "that the substrate of the device are separated by 'typically about 10 um'". *See Examiner's Office Action*, at 3-4.

[22] *Id.* at 3.

that Rumbaugh, individually and in combination with Daval and Salgo, fails to render the claimed inventions ***as a whole*** obvious because of fundamental differences between devices.

(4) The Combination of References Is Not Justified

Where a single prior art reference does not render an invention obvious, the Examiner must point to evidence that a skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed.[23] Thus, there must be "some teaching, suggestion, or motivation to combine the references."[24] Otherwise, the finding of obviousness would be based on nothing more than hindsight. The absence of such a teaching is a "critical omission".[25] The Examiner has the burden of making this showing,[26] for which broad conclusory statements that references should be combined will not suffice.[27]

Applicant has not found any teaching or suggestion in any one of the cited references to combine references in a manner to render the claimed inventions. Instead, it is submitted that the Examiner has done nothing more than identify individual claim elements in the Daval, Salgo and Rumbaugh references in an attempt to reconstruct the claimed inventions. As a matter of law, mere "identification in the prior art of ***each individual part claimed*** is insufficient to defeat patentability of the ***whole*** claimed invention."[28]

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[23] *Ecolochem. Inc. v. S. Cal. Edison Co.* 227 F.3d 1361, 1375 (Fed. Cir. 2000) (*quoting In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998)); *In re Kotzab,* 217 F.3d at 1371.

[24] *In re Rouffet*, 149 F.3d at 1355.

[25] *Ecolochem,* 227 F.3d at 1374.

[26] *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988).

[27] *In re Dembiczak,* 175 F.3d 994, 999-1000 (Fed. Cir. 1999) *abrogated on other grounds by In re Gartside,* 203 F.3d 1305 (Fed. Cir. 2000); *Ruiz v. A.B. Chance Co*., 234 F.3d 654, 664-65 (Fed. Cir. 2000).

[28] *In re Kotzab*, 217 F.3d 1365, 1370 (Fed. Cir. 2000) (emphasis added).

Daval and Salgo, representing the state of the art in 1973 and 1970, respectively, when far less was known, is merely an invitation to experiment. And as set forth above, Rumbaugh's later teaching is not illuminating. It is only with the benefit (and improper use) of hindsight, using the Applicant's invention as a blueprint, that Daval would be combined with the cited Salgo and Rumbaugh references to reconstruct the claimed inventions. Therefore, the combination of references employed by the Examiner is unjustified.

Unlike the present invention, known interferometers and etalons such as those in the cited references operate on the principle of interference, due to the ***parallel*** propagation of reflected beams within the cavity, to obtain sharp resonances and therefore very narrow band filters. See e.g., Daval and Salgo, above. The Applicant's inventions ***as a whole***, by having no interference within the cavity and having only interference in the beams outside of the cavity, are non-resonant band pass filters having the ability to control the frequency and bandwidth thereof.

The combination of Daval in view of Salgo in further view of Rumbaugh does not teach or suggest this important and distinguishable feature of the claimed inventions. Instead, it is submitted that the cited references are directed to ordinary interferometer devices, particularly the three decade old Daval and Salgo devices, each of which are designed to cause interference of light beams within the cavity of their respective devices.

PART 9 APPENDIX

Appendix A contains a copy of the claims involved in this appeal: claims 42-133, as amended and entered.

PART 10 CONCLUSION

Based on the above, Appellant-Applicant respectfully requests that this Board reverse the outstanding rejection of claims 42-133 under 35 U.S.C. § 103 over US Patent No. 3,758,194 to

Daval et al in view of US Patent No. 3,551,051 to Salgo in further view of US Patent No. 5,710,655 to Rumbaugh et al. The Applicant respectfully submits that the claimed invention is unobvious over the applied prior art. More particularly, the pending claims recite limitations that distinguish over Daval in view of Salgo in further view of Rumbaugh under 35 U.S.C. § 103. Accordingly, the rejection under 35 U.S.C. § 103 is overcome.

Respectfully submitted for Applicant,

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Date: March 10, 2005

APPENDIX A

CLAIMS ON APPEAL

42. An optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a very high reflective coefficient of r1;

b. a second substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof including: a transmission-optimized optical portion to facilitate input of light beams into said device and a reflective portion having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission coefficient of t to facilitate input and output of light beams in and out of said device; said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said second substrate, to: 1) hit a first point on said inner surface of said first substrate, 2) reflect off of said first point, at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said second substrate, said second point spaced from said optical portions so as not to interfere with said input light beam, 3) hit said second point and a) partially reflect off of said second point towards said reflective portion of said inner surface of said second substrate such that there is no interference of

reflected beams within said device and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates; and;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon.

43. An optical band pass device as in claim 42 wherein said near normal incidence angle is approximately 1 degree.

44. An optical band pass device as in claim 42 wherein said input light beam is a collimated light beam.

45. An optical band pass device as in claim 42 further comprising an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said first and second substrates and for adjusting the spacing between said inner surfaces of said first and second substrates;

46. An optical band pass device as in claim 42 further comprising a refractive index adjuster for adjusting the refractive index of said optical medium;

47. An optical band pass device as in claim 45 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing between said inner surfaces of said first and second substrates.

48. An optical band pass device as in claim 46 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

49. An optical band pass device as in claim 47 wherein said adjustable spacer is a

piezo-electric control voltage device.

50. An optical band pass device as in claim 48 wherein said refractive index adjuster is a voltage controlled electro-optical device.

51. An optical band pass device as in claim 42 further comprising:

a displacement transducer for measuring the changes in the spacing between said inner surfaces of said first and second substrates; said displacement transducer to generate a input signal for a controller; and

a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

52. An optical band pass device as in claim 42 wherein said optical converging element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

53. An optical band pass device as in claim 52 wherein said optical converging element converges said output light beams incident thereon into a focused spot.

54. An optical band pass device as in claim 53 wherein said focused spot is an input aperture of an output optical fiber.

55. A tunable optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a very high reflective coefficient of r1;

b. a second substrate having a very low absorption loss including an inner surface

and an outer surface; said inner surface thereof including: a transmission-optimized optical portion to facilitate input of light beams into said device and a reflective portion having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission coefficient of t to facilitate input and output of light beams in and out of said device; said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said second substrate, to: 1) hit a first point on said inner surface of said first substrate, 2) reflect off of said first point, at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said second substrate, said second point spaced from said optical portions so as not to interfere with said input light beam, 3) hit said second point and a) partially reflect off of said second point towards said reflective portion of said inner surface of said second substrate such that there is no interference of reflected beams within said device and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates; and;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon;

f. an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said substrates and for adjusting the

spacing between said inner surfaces;

g. a refractive index adjuster for adjusting the refractive index of said optical medium;

h. a displacement transducer for measuring the changes in the spacing between said inner surfaces of said first and second substrates; said displacement transducer to generate a input signal to be used by a controller; and;

i. a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

56. An optical band pass device as in claim 55 wherein said near normal incidence angle is approximately 1 degree.

57. An optical band pass device as in claim 55 wherein said input light beam is a collimated light beam.

58. An optical band pass device as in claim 55 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing between said first and second substrates.

59. An optical band pass device as in claim 58 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

60. An optical band pass device as in claim 58 wherein said adjustable spacer is a piezo-electric control voltage device.

61. An optical band pass device as in claim 59 wherein said refractive index adjuster is a voltage controlled electro-optical device.

62. An optical band pass device as in claim 55 wherein said optical converging

element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

63. An optical band pass device as in claim 62 wherein said optical converging element converges said output light beams incident thereon into a focused spot.

64. An optical band pass device as in claim 63 wherein said focused spot is an input aperture of an output optical fiber.

65. An optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a very high reflective coefficient of r1;

b. a second substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof including: a transmission-optimized optical portion to facilitate input of light beams into said device and a reflective portion having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission coefficient of t to facilitate input and output of light beams in and out of said device, said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other and said spacing between said inner surfaces being comparable with one wavelength of light;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said second substrate, to: 1) hit a first point on said inner surface of said first substrate, 2) reflect off of said first point, at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said second substrate, said second point spaced from said optical portions so as not to interfere with said input light beam, 3) hit said second point and a) partially reflect off of said second point towards said reflective portion of said inner surface of said second substrate such that there is no interference of reflected beams within said device and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates; and;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon.

66. An optical band pass device as in claim 65 wherein said near normal incidence angle is approximately 1 degree.

67. An optical band pass device as in claim 65 wherein said input light beam is a collimated light beam.

68. An optical band pass device as in claim 65 further comprising an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said first and second substrates and for adjusting the spacing between said inner surfaces of said first and second substrates;

69. An optical band pass device as in claim 65 further comprising a refractive index

adjuster for adjusting the refractive index of said optical medium;

70. An optical band pass device as in claim 68 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing between said inner surfaces of said first and second substrates.

71. An optical band pass device as in claim 69 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

72. An optical band pass device as in claim 70 wherein said adjustable spacer is a piezo-electric control voltage device.

73. An optical band pass device as in claim 71 wherein said refractive index adjuster is a voltage controlled electro-optical device.

74. An optical band pass device as in claim 65 further comprising:

a displacement transducer for measuring the changes in the spacing between said inner surfaces of said first and second substrates; said displacement transducer to generate an input signal for a controller; and

a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

75. An optical band pass device as in claim 65 wherein said optical converging element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

76. An optical band pass device as in claim 75 wherein said optical converging

element converges said output light beams incident thereon into a focused spot.

77. An optical band pass device as in claim 76 wherein said focused spot is an input aperture of an output optical fiber.

78. (CURRENTLY AMENDED) A tunable optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a very high reflective coefficient of r1;

b. a second substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof including: a transmission-optimized optical portion to facilitate input of light beams into the device and a reflective portion having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission coefficient of t to facilitate input and output of light beams in and out of said device, said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other and said spacing between said inner surfaces being comparable with one wavelength of light;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said second substrate, to: 1) hit a first point on said inner surface of said first substrate, 2) reflect off of said first point, at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said second substrate, said second point spaced from said optical portions so as not to interfere with said input light beam, 3) hit said second point and a) partially reflect off of said second point towards said reflective portion of

said inner surface of said second substrate such that there is no interference of reflected beams within said device and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon;

f. an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said substrates and for adjusting the spacing between said inner surfaces;

g. a refractive index adjuster for adjusting the refractive index of said optical medium;

h. a displacement transducer for measuring the changes in the spacing between said inner surfaces of said first and second substrates; said displacement transducer to generate a input signal to be used by a controller; and;

i. a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

79. An optical band pass device as in claim 78 wherein said near normal incidence angle is approximately 1 degree.

80. An optical band pass device as in claim 78 wherein said input light beam is a collimated light beam.

81. An optical band pass device as in claim 78 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing

between said inner surfaces of said first and second substrates.

82. An optical band pass device as in claim 81 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

83. An optical band pass device as in claim 81 wherein said adjustable spacer is a piezo-electric control voltage device.

84. An optical band pass device as in claim 82 wherein said refractive index adjuster is a voltage controlled electro-optical device.

85. An optical band pass device as in claim 78 wherein said optical converging element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

86. An optical band pass device as in claim 85 wherein said optical converging element converges said output light beams incident thereon into a focused spot.

87. An optical band pass device as in claim 86 wherein said focused spot is an input aperture of an output optical fiber.

88. An optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof including a first transmission-optimized optical portion and a reflective portion having a very high reflective coefficient of r1; said outer surface thereof including a second transmission-

optimized optical portion positioned opposite said first transmission-optimized optical portion; said first and second transmission-optimized optical portions to facilitate input of light beams into said device;

b. a second substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission coefficient of t to enable output of light beams; said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said first substrate, to: 1) hit a first point on said inner surface of said second substrate, 2) a) partially reflect off of said first point, at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said first substrate, said second point spaced from said optical portions so as not to interfere with said input light beam and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams, and 3) hit said second point and reflect off of said second point towards said reflective portion of said inner surface of said second substrate in such a manner that there is no interference of reflected beams within said device;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates; and;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon.

89. An optical band pass device as in claim 88 wherein said near normal incidence angle is approximately 1 degree.

90. An optical band pass device as in claim 88 wherein said input light beam is a collimated light beam.

91. An optical band pass device as in claim 88 further comprising an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said first and second substrates and for adjusting the spacing between said inner surfaces of said first and second substrates.

92. An optical band pass device as in claim 88 further comprising a refractive index adjuster for adjusting the refractive index of said optical medium.

93. An optical band pass device as in claim 91 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing between said inner surfaces of said first and second substrates.

94. An optical band pass device as in claim 92 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

95. An optical band pass device as in claim 93 wherein said adjustable spacer is a piezo-electric control voltage device.

96. An optical band pass device as in claim 94 wherein said refractive index adjuster is a voltage controlled electro-optical device.

97. An optical band pass device as in claim 88 further comprising:

a displacement transducer for measuring the changes in the spacing between said inner surfaces; said displacement transducer to generate a input signal for a

controller; and

a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

98. An optical band pass device as in claim 88 wherein said optical converging element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

99. An optical band pass device as in claim 98 wherein said optical converging element converges said output light beams incident thereon into a focused spot.

100. An optical band pass device as in claim 99 wherein said focused spot is an input aperture of an output optical fiber.

101. A tunable optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof including a first transmission-optimized optical portion and a reflective portion having a very high reflective coefficient of r1; said outer surface thereof including a second transmission-optimized optical portion positioned opposite said first transmission-optimized optical portion; said first and second transmission-optimized optical portions to facilitate input of light beams into said device;

b. a second substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission

coefficient of t to enable output of light beams; said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said first substrate, to: 1) hit a first point on said inner surface of said second substrate, 2) a) partially reflect off of said first point, at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said first substrate, said second point spaced from said optical portions so as not to interfere with said input light beam and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams, and 3) hit said second point and reflect off of said second point towards said reflective portion of said inner surface of said second substrate in such a manner that there is no interference of reflected beams within said device;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon;

f. an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said substrates and for adjusting the spacing between said inner surfaces;

g. a refractive index adjuster for adjusting the refractive index of said optical medium;

h. a displacement transducer for measuring the changes in the spacing between said

inner surfaces of said first and second substrates; said displacement transducer to generate a input signal to be used by a controller; and;

i. a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

102. An optical band pass device as in claim 101 wherein said near normal incidence angle is approximately 1 degree.

103. An optical band pass device as in claim 101 wherein said input light beam is a collimated light beam.

104. An optical band pass device as in claim 101 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing between said inner surfaces of said first and second substrates.

105. An optical band pass device as in claim 101 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

106. An optical band pass device as in claim 104 wherein said adjustable spacer is a piezo-electric control voltage device.

107. An optical band pass device as in claim 105 wherein said refractive index adjuster is a voltage controlled electro-optical device.

108. An optical band pass device as in claim 101 wherein said optical converging element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

109. An optical band pass device as in claim 108 wherein said optical converging element converges said output light beams incident thereon into a focused spot.

110. An optical band pass device as in claim 109 wherein said focused spot is an input aperture of an output optical fiber

111. An optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof including a first transmission-optimized optical portion and a reflective portion having a very high reflective coefficient of r1; said outer surface thereof including a second transmission-optimized optical portion positioned opposite said first transmission-optimized optical portion; said first and second transmission-optimized optical portions to facilitate input of light beams into said device;

b. a second substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission coefficient of t to enable output of light beams; said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other and said spacing between said inner surfaces being comparable with one wavelength of light;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said first substrate, to: 1) hit a first point on said inner surface of said second substrate, 2) a) partially reflect off of said first point,

at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said first substrate, said second point spaced from said optical portions so as not to interfere with said input light beam and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams, and 3) hit said second point and reflect off of said second point towards said reflective portion of said inner surface of said second substrate in such a manner that there is no interference of reflected beams within said device;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates; and;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon.

112. An optical band pass device as in claim 111 wherein said near normal incidence angle is approximately 1 degree.

113. An optical band pass device as in claim 111 wherein said input light beam is a collimated light beam.

114. An optical band pass device as in claim 111 further comprising an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said first and second substrates and for adjusting the spacing between said inner surfaces of said first and second substrates.

115. An optical band pass device as in claim 111 further comprising a refractive index adjuster for adjusting the refractive index of said optical medium.

116. An optical band pass device as in claim 114 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing between said inner surfaces of said first and second substrates.

117. An optical band pass device as in claim 115 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

118. An optical band pass device as in claim 116 wherein said adjustable spacer is a piezo-electric control voltage device.

119. An optical band pass device as in claim 117 wherein said refractive index adjuster is a voltage controlled electro-optical device.

120. An optical band pass device as in claim 111 further comprising:

a displacement transducer for measuring the changes in the spacing between said inner surfaces of said first and second substrates; said displacement transducer to generate a input signal for a controller; and

a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

121. An optical band pass device as in claim 111 wherein said optical converging element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

122. An optical band pass device as in claim 121 wherein said optical converging element converges said output light beams incident thereon into a

focused spot.

123. An optical band pass device as in claim 121 wherein said focused spot is an input aperture of an output optical fiber.

124. A tunable optical band pass device, comprising:

a. a first substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof including a first transmission-optimized optical portion and a reflective portion having a very high reflective coefficient of r1; said outer surface thereof including a second transmission-optimized optical portion positioned opposite said first transmission-optimized optical portion; said first and second transmission-optimized optical portions to facilitate input of light beams into said device;

b. a second substrate having a very low absorption loss including an inner surface and an outer surface; said inner surface thereof having a reflective coefficient of r2 wherein r1 is greater than r2; said outer surface thereof having a transmission coefficient of t to enable output of light beams; said second substrate mounted parallel to said first substrate with respective inner surfaces facing each other and said spacing between said inner surfaces being comparable with one wavelength of light;

c. a beam collimating element positioned to guide an input light beam to travel through said optical portions of said first substrate, to: 1) hit a first point on said inner surface of said second substrate, 2) a) partially reflect off of said first point, at a near normal incidence angle, towards a second point on said reflective portion of said inner surface of said first substrate, said second point spaced from said

optical portions so as not to interfere with said input light beam and b) partially travel through said respective surfaces of said second substrate to generate said one of said output light beams, and 3) hit said second point and reflect off of said second point towards said reflective portion of said inner surface of said second substrate in such a manner that there is no interference of reflected beams within said device;

d. an optical medium having a predetermined refractive index located between said inner surfaces of said first and second substrates; and;

e. an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon.an optical converging element spaced from said outer surface of said second substrate for converging said output light beams incident thereon;

f. an adjustable spacer positioned between said inner surfaces of said first and second substrates for parallel mounting of said substrates and for adjusting the spacing between said inner surfaces;

g. a refractive index adjuster for adjusting the refractive index of said optical medium;

h. a displacement transducer for measuring the changes in the spacing between said inner surfaces of said first and second substrates; said displacement transducer to generate a input signal to be used by a controller; and;

i. a controller for monitoring the tunable operation of said interferometer using said input signal generated by said displacement transducer.

125. An optical band pass device as in claim 124 wherein said near normal

incidence angle is approximately 1 degree.

126. An optical band pass device as in claim 124 wherein said input light beam is a collimated light beam.

127. An optical band pass device as in claim 124 further comprising a first voltage source connected to said adjustable spacer for electrically adjusting the spacing between said inner surfaces of said first and second substrates.

128. An optical band pass device as in claim 127 further comprising a second voltage source connected to said refractive index adjuster for electrically adjusting the refractive index of said optical medium.

129. An optical band pass device as in claim 127 wherein said adjustable spacer is a piezo-electric control voltage device.

130. An optical band pass device as in claim 128 wherein said refractive index adjuster is a voltage controlled electro-optical device.

131. An optical band pass device as in claim 124 wherein said optical converging element is chosen from the group consisting of a spherical lens system, an aspherical lens system, a gradient-index (GRIN) lens system, any combination of the foregoing systems, and any other optical converging system constructed to collect and converge said output light beams.

132. An optical band pass device as in claim 131 wherein said optical converging element converges said output light beams incident thereon into a focused spot.

133. An optical band pass device as in claim 132 wherein said focused spot is an input aperture of an output optical fiber.

Effective on 12/08/2004.
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL
For FY 2005

☑ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT	($) 250

Complete if Known	
Application Number	09/705,447
Filing Date	11/03/200
First Named Inventor	MIRON
Examiner Name	LYONS
Art Unit	2877
Attorney Docket No.	086112-32NP

METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): ______

☑ Deposit Account Deposit Account Number: 06-0923 Deposit Account Name: Goodwin Procter LLP

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☑ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☑ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17 ☑ Credit any overpayments

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

	FILING FEES		SEARCH FEES		EXAMINATION FEES		
Application Type	**Fee ($)**	**Small Entity Fee ($)**	**Fee ($)**	**Small Entity Fee ($)**	**Fee ($)**	**Small Entity Fee ($)**	**Fees Paid ($)**
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	**Fee ($)**	**Small Entity Fee ($)**
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims ______ - 20 or HP = **Extra Claims** ______ x **Fee ($)** ______ = **Fee Paid ($)** ______

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims ______ - 3 or HP = **Extra Claims** ______ x **Fee ($)** ______ = **Fee Paid ($)** ______

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims
Fee ($) ______ **Fee Paid ($)** ______

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets ______ - 100 = **Extra Sheets** ______ / 50 = **Number of each additional 50 or fraction thereof** ______ (round **up** to a whole number) x **Fee ($)** ______ = **Fee Paid ($)** ______

4. OTHER FEE(S) **Fees Paid ($)**

Non-English Specification, $130 fee (no small entity discount) ______

Other (e.g., late filing surcharge): Filing a brief in support of an appeal 250

SUBMITTED BY

Signature	Patrice King	Registration No. (Attorney/Agent) 44,833	Telephone 9739921990
Name (Print/Type)	Patrice King		Date 3/10/2005